It is a basic principle of furnace design that satisfactory results cannot be obtained unless the flame licks the sole of the furnace. It is likewise well known that bottom cannot be made in an open-hearth furnace unless the flame can drop down far enough to sinter the bottom in place, no matter how luminous the flame may be. One of the hottest flames is that of the oxy-acetylene torch. Acetylene burned in air gives a very luminous flame, but when this flame is supplied with oxygen it becomes a blue non-luminous flame. The luminous acetylene flame does not emit an excessive amount of radiant heat to any recipient surface. It is rather noticeable that when the oxy-acetylene torch is used in welding it is necessary for the flame to impinge upon the work, and that the work has a tendency to become luminous, while the flame itself has a very slight luminosity, and that at the tip only. The mixed producer gas which is used in numerous Siemens furnaces derives its heating value mainly from carbon monoxide and hydrogen. These two combustibles are the main constituents of blue water gas. In fact, blue water gas bears a fairly close resem-blance to a good mixed producer gas from which the nitrogen has been removed.

Radiant heat from a luminous flame may also be considered from another viewpoint. The roof, side walls and bath are at a high temperature and emit a certain amount of light, depending upon their temperature and emissivity. The flame is sufficiently transparent, when the furnace is at a high temperature, to permit the opposite wall and the slag surface to be seen. The red and yellow portion of the flame, which emits the most visible light, is not transparent and is at a lower temperature than the blue transparent portion. A smoky flame is caused by the presence

of soot or unignited carbon. Soot may be caused by the dissociation of carbon monoxide when this gas is chilled by impinging upon cold metal.

Stratification is frequently observed in the flame. Cool gases tend to collect below hotter gases. The hottest gases tend to rise to the roof where they are cooled. The coldest gases would have a tendency to collect on the surface of the bath, but the jet of flame from the ports tends to sweep them away. Convection currents are rarely appreciated at their true value. A temperature difference of 1° C. is sufficient to impress a velocity of 0.268 m (0.88 ft) per second and this velocity will increase as